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POST-MORTEM EXAMINATIONS OF WILD BIRDS AND MAMMALS

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CONTENTS

NOTING AND REPORTING DISEASE CONDITIONS

Field workers of the Federal Government and their cooperators engaged in activities involving wildlife frequently come across sick and dead animals of various species. Prompt examination of specimens where found and before decomposition sets in may be of great value in determining the cause of sickness or death. The purpose of this publication is to assist field workers in noting abnormal conditions and in helping to eradicate them by reporting the facts observed to wildlife disease-control specialists. It is not to be expected that a simple set of directions will make it possible to recognize all the many abnormal conditions affecting wildlife. When observations are carefully made and systematically recorded, however, they can be highly useful to investigators charged with these specialized investigations.

Any deviation from the normal should be regarded as evidence of disease, and, hence, any defects or changes in the body tissues must be taken into consideration when studying wildlife losses. To recognize the abnormal when encountered requires a reasonable knowledge of the normal appearance of organs and tissues. Field men, therefore, should examine animals killed in hunting whenever possible in order to familiarize themselves with the size, color, consistency, and general characteristics of normal organs.

[1] Part of the manuscript of this publication was prepared by the junior author while employed by the Forest Service to make game studies in the national forests.

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Though many veterinarians have special training in animal pathology, it is frequently impractical to have specialists in the field where disease in wildlife is prevalent. Wherever feasible, however, veterinarians should be employed in making autopsies.

In all cases where there are heavy losses in wildlife, special effort should be made to bring the information immediately to the attention of local game wardens, the regional or local official of the Biological Survey, the State department of conservation, and (if on a national forest) the local officer of the Forest Service. Likewise local veterinarians should be notified in order to permit a prompt diagnosis and thus forestall epizootics if possible and prevent the possibility of a serious menace to domestic stock and human beings. When outbreaks of disease are noted, specimens for laboratory examination should be transmitted to the laboratories of the Biological Survey or of its cooperators listed on page 14.

CAUSES OF DEATH

Close observations have shown that few wild animals actually die of old age. Food shortage, accidental injuries, diseases, and natural enemies are the principal causes of death in animals found dead on their ranges. Apparently a greater loss from these causes occurs among the young and very old than among those of greater vigor in middle life. From the wildlife-management standpoint it is important to determine as accurately as possible the role of the various destructive factors. This is especially important in the case of game, fur, and other valuable species. Studies also should be made, however, of the predatory and other nongame species, since the latter groups may play an important part in the spread of disease in other more valuable forms. Whenever practicable, systematic post-mortem examinations should be made of all mammals and birds found dead.

In all studies of wildlife losses the observer should note the general conditions affecting the welfare of the animals, such as environment, food, natural enemies, and weather. In recording the history of a disease outbreak he must take cognizance of both the number of individuals and the species affected. Some diseases frequently affect a large proportion of the wildlife population, while others leave many individuals unaffected. In some instances the young are predominately affected. Certain ailments depend on local conditions. This is especially the case when the diseases are caused by water pollution, poisoning, or parasitism. When a carcass is found, note should be made of any signs or clues in the vicinity that may develop information on the cause of sickness or death.

SYMPTOMS OF DISEASE

Since wild animals frequently show no outward evidence of disease until they become so weak that they no longer have the physical strength to fly or walk, most of the specimens are not found until after death. Then there is no opportunity to note characteristic symptoms or behavior. When, however, sick animals are found they should be kept under observation long enough to detect any symptoms that may give a clue to the nature and cause of the disease. There can be little of diagnostic value in noting the pulse rate or the temperature by use of a thermometer, since excitement, restraint, or disturbances may produce radical fluctuations even in a completely

healthy wild subject. The duration of a malady may be of importance, however, as some diseases kill in a short time whereas others assume a more chronic character, with a gradual loss of flesh and strength.

PERFORMING AUTOPSIES ON MAMMALS

Examinations both external and internal should be made unhurriedly, in daylight when feasible, and dissections should be made in a clean place, since cleanliness is essential to efficiency in study. Autopsies should be made as soon after death as practicable, since morbid conditions may be obscured by early decomposition changes. Examinations should always be made, however, as it may be possible in some instances to detect the cause of death a long time afterward.

When autopsies are made care should be taken not to allow body tissues, fluids, or ingesta to contaminate the water supply, the soil, or the range used by other stocks of wild or domestic animals. Burning or deep burying are the best means of disposing of carcasses.

EXTERNAL FACTORS

Mammal specimens should be examined for outward evidence of injury, such as gunshot wounds, bruises, or broken bones. The position of head and legs also may suggest the cause of death, especially if poison is suspected. Note should be made of any discharges from

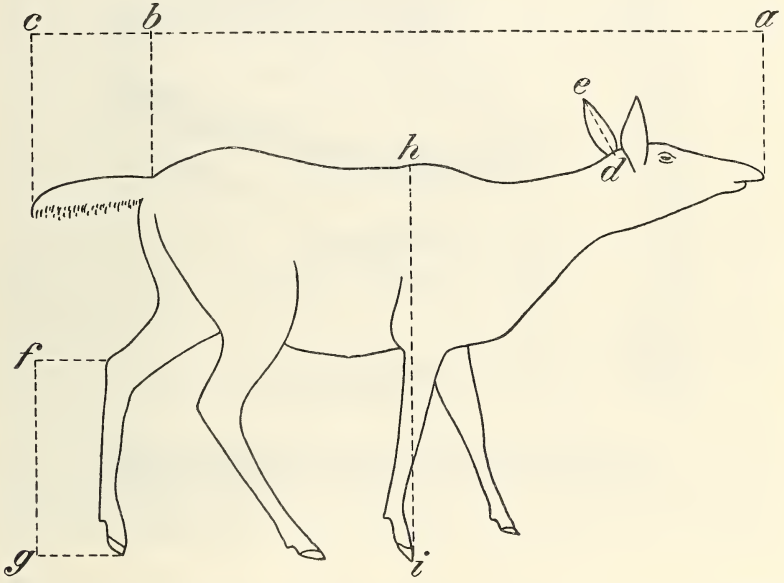

FIGURE 1.—Measurements to be recorded of mammals autopsied: *ac*, Total length; *hi*, shoulder height; *fg*, hind leg; *de*, left ear; *bc*, tail.

natural openings of the body. A careful examination should be made for external parasites, record should be made of the relative numbers present, and a few of each type should be collected for identification. The description and character of the pelage should be noted, as well as the apparent age, weight (actual weight whenever

possible), and size of the animal, and for record purposes the following measurements should be made (fig. 1):

Total length.—From tip of nose to end of tail vertebrae, measured in a straight line, the animal being placed on its back and extended without being unduly pulled or stretched (*a* to *c*).

Shoulder height.—From between the shoulders on spine to tip of toes; adjust leg to position when standing (*h* to *i*).

Hind leg.—From hock (tarsal) joint to tip of toes, with leg flattened and moderately stretched (*f* to *g*).

Left ear.—From base of ear at crown of head to tip of cartilege (*d* to *e*).

Tail.—From base of spine to tip of tail bones (*b* to *c*).

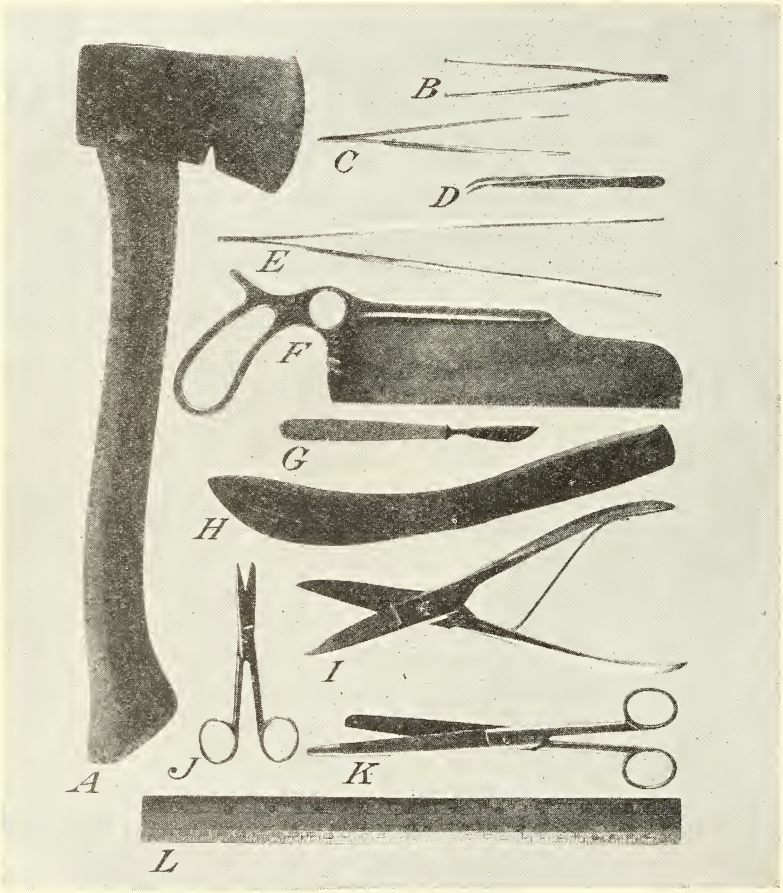

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FIGURE 2.—Instruments needed in performing autopsies on mammals and birds. The number varies with size and type of specimen examined: *A*, Hand ax; *B*, rat-tooth forceps; *C*, blunt forceps; *D*, curved forceps; *E*, large forceps; *F*, bone saw; *G*, scalpel; *H*, skinning-knife; *I*, bone forceps; *J*, scissors; *K*, enterotome; *L*, ruler.

DISSECTION

Instruments necessary for dissection will vary with the size of the specimens examined. For all practical purposes the following should suffice: Tissue forceps, bone forceps, scissors, scalpel, saw, enterotome, and hand ax, or cleaver (fig. 2).

A deer or other large mammal should be placed on the left side, and the right legs should then be removed by disjointing the hind leg at the hip and severing the muscles and ligaments of the foreleg between the shoulder blade and ribs, as illustrated in figure 3, *A*. This is a simple operation, and a hunting knife is the only instrument required. If a blood sample is desired it can be taken from the cut arteries in the shoulder.

The next step is to make a deep incision on the right side of the spine, using the knife to cut through the skin and back muscles to the ribs. These bones should then be cut with an ax or cleaver, after which the entire right side of the body wall may be turned over on its lower margin by severing the edges at the neck and along the flank and cutting the diaphragm as the ribs are raised (fig. 3, *B*.) By turning the right body wall outward a good surface is provided on which to place the organs for further study (fig. 4, *A*).

CONDITION OF INTERNAL ORGANS

When the body cavity is properly opened the organs should be inspected for external evidences of inflammation, abscesses, or other abnormalities. The soft organs may be further examined by manipulation to determine whether there are solid areas within that might indicate pneumonia, tuberculosis, or other disease conditions not evident on the surface.

DIGESTIVE SYSTEM

Inflammatory changes due to digestive disturbances or infectious disease may be noticeable on exterior parts of the alimentary canal. The site of any unusual condition should be recorded, and special examination made when the organs are opened.

For practical purposes the digestive tract may be considered as composed of the following specialized organs:

1. Mouth, the part within the head.
2. Pharynx, the section in the throat.
3. Esophagus (gullet), the part extending from pharynx to stomach.
4. Stomach, the large, expanded section where most of the digestion takes place. In deer, elk, bison, moose, antelope, goats, sheep, and other ruminant mammals, it is divided into four distinct compartments.
5. Small intestine, the long part of the intestinal tube extending from stomach to caecum.
6. Caecum, a large pouch, or blind tube, in the right flank, with the two openings to the small and large intestines, respectively, close together near the upper end.
7. Large intestine, the posterior portion, extending from caecum to anus.

The intestine may be removed with little soiling if care is exercised not to break its thin walls or to cut any large blood vessels connected with the liver or beneath the spine. Some dissection is necessary, especially at the anterior 3 or 4 feet near the attachment to the stomach. The remainder of the intestinal tube may be withdrawn from its position and placed on the surface provided by the body wall as in figure 3, *B*.

The entire digestive tract should be opened with the enterotome and a careful search made for parasitic and other organisms causing disease. A number of specimens of each type of parasitic worm should be collected for identification by specialists and a count or an estimate made of the number present in each organ. In order to handle the various parts of the digestive tract with ease and to avoid

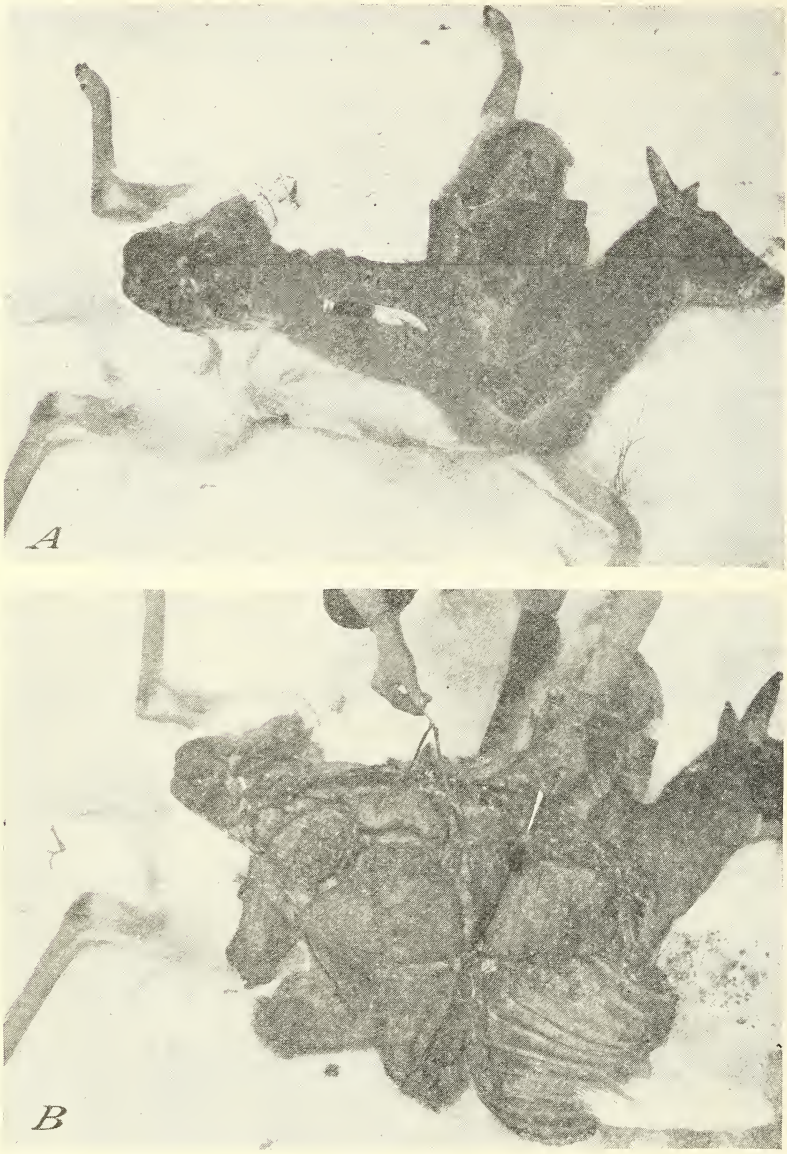

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FIGURE 3.—Dissected deer illustrates a typical mammalian autopsy. *A*, First operation on mammal—excision of right shoulder and disjointing of right thigh, the animal being placed on its left side for the purpose; *B*, second operation on mammal—use knife to cut through skin and muscles to ribs, and ax or cleaver to cut through the bones, thus enabling operator to turn down entire right side after severing edges at neck and along flank and cutting diaphragm as ribs are lifted.

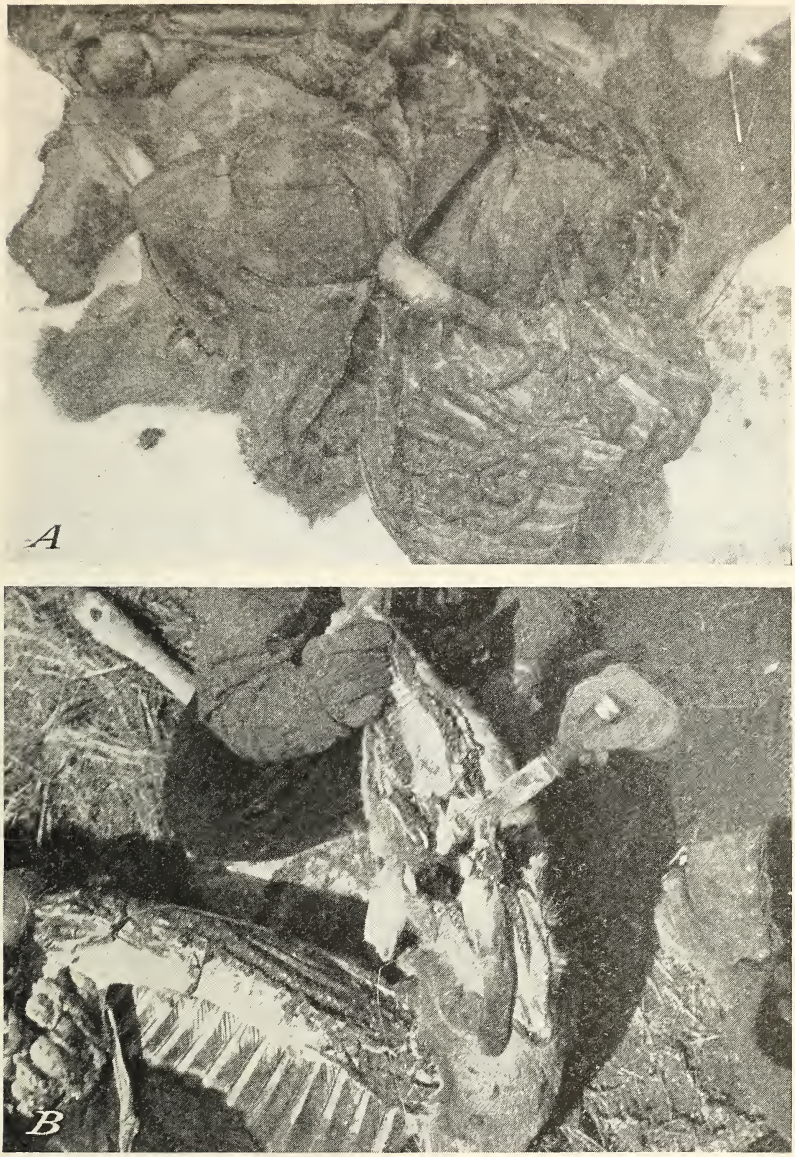

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FIGURE 4.—*A*, The inner side of the ribs provides a good surface on which to place internal organs during the progress of dissection; *B*, the operation for removing lower mandible from upper part of head involves incisions from angles of mouth toward base of ear and then forcing away by pressure. Larvae of parasitic insects may here be exposed to view.

mixing the contents it may be tied in two places with a cord near the divisions of the various parts above named and then severed between the cords. In this manner each part can be examined in detail for evidence of inflammation, unnatural growths, parasites, and food content. Special note should be made of the kind and quantity of food in the stomach. If there is reason to suspect poisoning, the complete stomach should be removed and placed in a clean tight container for chemical analysis.

LIVER AND SPLEEN

The liver and spleen are usually removed with the stomach. Note should be made of their size and consistency, whether extra large or shrunken, and whether especially fibrous or pulpy and easily broken. Within the tissues of the liver, or in the membranes surrounding liver or intestines, may be found cysts, composed of a thin membrane, filled with clear fluid, and containing one or more small whitish masses. These should be saved for examination by specialists. The liver may also be parasitized by flukes—short flat worms of varying sizes that burrow into the bile ducts.

LUNGS AND HEART

The lungs and heart may be removed together by severing the trachea (windpipe) near the head and the membranes and blood vessels in the thoracic cavity. The lungs should be carefully examined for solid areas indicating pneumonia or lungworm infestation. It is usually possible to find the lungworms by using a small enterotome or a pair of scissors to slit the lung tissue by following the bronchi or the small air tubes leading to the affected parts. Lungworms are long, threadlike, white or pinkish worms. Few pathological conditions causing death are apparent through field examination of the heart.

KIDNEYS AND BLADDER

Little can be determined in the field from the appearance of the kidneys; cysts, abscesses, and urinary calculi (kidney stones), however, should be sought. The bladder should be opened to observe any unusual appearance. Urinary calculi may be found within the bladder as well as in the small tubes leading to it from the kidneys, and in the urethra, or tube leading from the bladder.

REPRODUCTIVE ORGANS

In females special note should be made of the condition of the uterus. If it is normal in external appearance an examination should be made of its interior to learn whether any foetuses are present and, if so, the number and approximate size. The more common abnormalities to be looked for are infections and pus in the uterus and cysts in the ovaries.

EXAMINATION OF THE HEAD

Field examinations of the head should include all parts except the brain. Here as in other parts of the body close observation should be made to detect parasitic infestation and abscess formations, especially decayed and abscessed teeth. The lower mandible (jaw) may be removed as shown in figure 4, *B*. This is done by cutting through the skin and muscles of the side of the head from the angles of the

mouth back toward the base of the ear and pressing the lower mandible away from the upper part of the head. In some animals it may become necessary to use an ax or cleaver to break or cut the hinge of the mandible.

As the posterior parts of the mouth and pharynx are exposed one should be on the lookout for nose-fly larvae. In fresh specimens these are usually attached to the mucous membranes. In specimens that have been dead and cold for some time the larvae may detach themselves and crawl about. They are usually of a yellowish-white color and are covered with rings or stiff spines. They may be attached to the mucous membrane lining the nasal passages, the soft palate, or the sinuses of the head, as well as in various parts of the throat. If these parasites are abundant the investigator should look for evidences of suffocation.

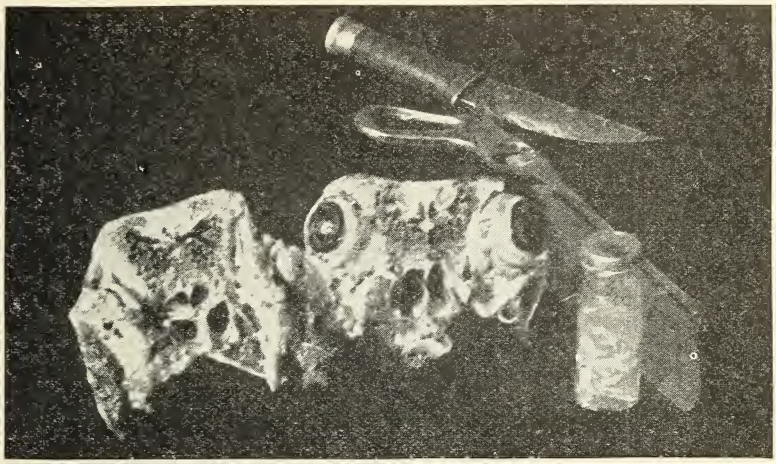

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FIGURE 5.—Head, skinned and muscles removed; the next step is to saw through transversely just in front of eyes, in order to examine the sinuses.

In order to examine the sinuses, the head should be skinned and the muscles removed from the crown, and then the the head sawed through transversely just in front of the eyes, as illustrated in figure 5. It may also be desirable further to divide the skull by splitting the bones on each side with an ax.

For the purpose of removing the brain of large animals for examination, the cranium may be sawed through the median line and each half lifted from its cavity. In smaller animals the skull should be sawed through around the margin of the brain, and then, by exerting a little force, the cap can be completely lifted and the brain removed entire. A dexterous operator may also use this method with large specimens.

PERFORMING AUTOPSIES ON BIRDS

EXTERNAL FACTORS

In studying losses in birds the procedure is somewhat similar to that used for mammals. The position and location of a bird when first observed may give convincing evidence of the cause of death.

If close to a highway, it may have been struck by an automobile. If loose feathers are near by, the work of a natural enemy may be indicated. A familiarity with the conditions prevailing in that locality is an important guide, as, for example, the occurrence of botulism in the western alkaline-lake region. Blood on the plumage, broken bones in legs or wings, or a broken beak furnish important diagnostic evidence. Actual death is frequently caused by predators after a bird has been weakened by injury or disease.

Before dissection for internal examination, the plumage and skin should be examined for external parasites. Specimens of each kind should be collected if possible and placed in dry, tight containers for examination by specialists. Among the visible organisms parasitic on birds are various species of lice, fleas, ticks, and mites. Some of these are so small, however, that it is difficult to detect them except by close observation in a good light.

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FIGURE 6.—Carcass of duck illustrates a typical avian autopsy, the whole breast removed to expose internal organs without cutting or displacing them.

INTERNAL EXAMINATION

To get a clear view of the internal organs without interference by feathers it is well to pluck or skin the bird before opening the body cavity. The bird should be placed on its back and the posterior part of the body opened with a knife or scissors, care being used not to cut any of the organs. With heavy scissors or bone forceps the anterior part of the body wall supported by bones can be cut through on each side. The breast can then be removed entire in such manner as to expose the organs without displacing them (fig. 6).

The body cavity as well as the organs should then be examined for abnormal appearances, such as inflammation, pus, abscesses, hemorrhages, or cysts. Enlargements, especially of the parts anterior to the gizzard in waterfowl and of enlarged hard caeca in upland game

birds, should be noted. The liver and spleen should be thoroughly examined for discolorations, particularly in the nature of whitish spots.

The interior of the digestive canal should be opened and examined in a manner similar to that described for mammals. Care is necessary to detect many of the forms of small parasitic worms that inhabit the digestive tract. When these are found they should be collected for identification by experts.

The contents of the gizzards of waterfowl should be sedimented in several washings of clear water and the heavy particles examined for lead shot. These may be difficult to distinguish, as they are likely to be ground into small irregular shapes by the action of grit in the gizzard.

COMMON CAUSES OF WILDLIFE LOSSES

NECROTIC STOMATITIS

Necrotic stomatitis, or necrobacillosis, in ruminant animals occurs most frequently on preserves or concentration areas where the animals receive supplementary feed. The causative organism (*Actinomyces necrophorus*) may exist for long periods in decaying organic matter, such as accumulations of manure or other litter in damp places. The germs usually gain entrance through abrasions of the mucous membrane of the mouth, especially about the teeth. Their growth causes rapid destruction of the soft tissues of the mouth and later attacks the teeth and the jawbone. In some instances the infection becomes established in the internal organs also and is manifested in the form of abscesses in liver, lungs, and other organs.

PNEUMONIA

Pneumonia is a general term indicating an inflammation of the lungs. It is generally associated with some irregularity or with an unusual occurrence in the life habits of the animal. Marked congestion, consolidations, or pronounced discoloration of the lung tissue is evidence of pneumonia, which may affect either the whole or parts of both lungs. When pneumonia is found, close observations should be made either in field or laboratory to determine whether it is associated with lungworm infection.

ENTERITIS

Enteritis, or inflammation of the intestines, accompanies various forms of parasitic infestations, infectious diseases, or digestive disturbances. Changes in the color of the intestinal canal, increase in thickness of walls, and accumulation of excessive quantities of mucus are characteristic. Enteritis may be present throughout the entire length of the intestinal tract or it may be evident only in limited sections. When an inflammation of the intestinal tract is noticed close examination should be made for parasites visible to the naked eye, and specimens should be taken for laboratory search for microscopic parasites.

TULAREMIA

Tularemia, frequently referred to as rabbit fever, is found in a great variety of mammals and birds. No characteristic symptoms are noticeable other than droopiness and weakness. On autopsy

the liver and spleen of typically affected specimens show many small whitish gray or yellowish spots, which may be so numerous as to cause a definitely gray appearance. As this disease is highly infectious to human beings, special precautions should be taken to avoid allowing the bare hands to come in contact with diseased specimens. The disease is spread in nature by biting insects and ticks, and these as well as the blood or tissues of affected specimens may communicate the infection to man.

BOTULISM

Botulism is a form of food poisoning causing extensive losses in waterfowl. It is not infectious but is caused by the ingestion of food in which the botulinum bacteria have grown and produced great quantities of toxin. Losses from this disease have been most extensive among waterfowl and shore birds on western alkaline lakes. Outbreaks usually occur on a low or receding water level late in summer, but they may also appear when the soil becomes polluted in small pens where waterfowl are being propagated under artificial conditions. Autopsy may not reveal any characteristic lesions. Provisional diagnosis can be made on environmental conditions, but positive identification can be made only in the laboratory. The symptoms of affected birds are weakness and in severe cases progressive paralysis. If the birds have not ingested too much toxin they may recover if removed from the unhealthy area.

LEAD POISONING

Lead poisoning is a common cause of loss among wild ducks, geese, and swans that pick up shot on the marshes where they feed. The lead from the pellets is ground up in the gizzards and slowly absorbed, the cumulative action of this poison causing progressive paralysis of certain muscles. Drooping of the wings and advancing weakness are the most noticeable symptoms. On autopsy, the proventriculus is often found distended with food; and shot, or worn-down fragments of shot that have lost their spherical form, will usually be found in the gizzard.

PARASITISM

Parasitism is generally manifested by an unthrifty condition of affected subjects. External parasites, including lice, fleas, and mange mites, are usually transmitted by direct contact between animals, while ticks are picked up from infested vegetation and premises. Internal parasites are generally obtained through the ingestion of food contaminated with eggs passed in the feces of other infested hosts. Many internal parasites, however, such as tapeworms and flukes, require two or more hosts to complete the life cycle, and in such cases infestation of the primary hosts with adult tapeworms and flukes comes about through eating the intermediate hosts infested with the larval stages. Worm parasites may be found in practically every part of the body, but they are more commonly encountered in the digestive and respiratory organs. They interfere with the functioning of these parts and destroy considerable tissue where attached or embedded. Lungworms injure

tissues where lodged and cause the collection of a considerable quantity of mucus. Pneumonia not infrequently follows lungworm lesions.

STARVATION

Starvation is one of the most important contributing causes of loss in wild birds and mammals. Herds of deer are notably apt to remain on their customary feeding range in over-dense populations until the browse is insufficient to sustain them. Likewise waterfowl accustomed to winter on certain bodies of water have been observed suffering from extreme emaciation. Malnutrition favors the action of parasites and the destructiveness of predators. The presence of parasites, however, should not lead to a diagnosis of death from that cause until a complete investigation is made by a competent observer of the abundance or scarcity of suitable food. The mere presence of ample ingesta in the alimentary tract does not necessarily prove freedom from malnutrition. In emaciation the fatty tissues become greatly reduced or absent and the muscular and tendonous tissues become anemic. They are flabby to the touch and have a watery, slimy, or gelatinous consistency.

PRESERVING SPECIMENS FOR STUDY

When diseases are encountered in the field and diagnosis requires laboratory facilities, it is important that suitable material be properly preserved for examination by specialists. Worm parasites may be placed in a 2-percent solution of formalin for a few hours and then transferred to one of 70-percent alcohol or 50-percent glycerin. If facilities are available, placing the worms in hot 70-percent alcohol is the best method of killing them for laboratory study. They may then be shipped in the same fluid. Under the United States postal regulations, liquid formalin may not be sent by mail. Specimens preserved in formalin may be wrapped in cloths dampened with this fluid and then packed in tight substantial mailing containers.

Rodents, birds, and other small specimens collected for laboratory examination should be kept entire. Refrigeration, preferably by means of solid carbon dioxide, is the best means of preservation for the purpose. In cool weather, however, they may be sent with no preservative or refrigeration if they can be delivered promptly.

When botulism (sometimes referred to as western duck sickness) is suspected in waterfowl, and it is impracticable to send the entire bird to a laboratory, the liver may be removed, placed in a tightly stoppered wide-mouthed bottle or securely capped jar, and transmitted without preservative.

Subjects suspected of being affected with tularemia should be sent entire under refrigeration if possible. If the whole carcass cannot be sent, a portion of muscle tissue and the liver may be placed in separate tight containers and mailed to the laboratory without preservative other than refrigeration. These tissues may be placed in glycerin, either pure or in a dilution of 50 percent with water, if solid carbon dioxide, ice, or other refrigerants are not available. In emergencies, and if the distance to be traversed is short, these tissues may be transmitted with no preservative whatever.

SHIPPING SPECIMENS TO THE LABORATORY

The quickest means of transportation to the laboratory is always recommended in order that the least possible changes in tissue may take place between time of collection and time of examination. Care should be taken to see that the address on the package is complete and correct in order to aid in speedy delivery.

The sender should place in each container with the specimen a label giving the following information: (1) Name of mammal or bird; (2) sex; (3) approximate age; (4) where found; (5) date; (6) field diagnosis, with all additional information pertaining to the subject; (7) if parasites, location found and approximate numbers; and (8) name and address of sender.

In addition he should mail a letter to the laboratory under separate cover, giving a complete history of the situation involving the death of the specimen.

WHERE TO SHIP

The Bureau of Biological Survey of the United States Department of Agriculture is the Federal agency specifically responsible for wildlife research. Material collected in field studies, therefore, and reports made of wildlife losses, should be referred to the Washington or field offices of that Bureau. Specimens collected in localities adjacent to Washington, D. C., should be addressed as follows:

Department of Agriculture,
Biological Survey Disease Control Laboratory,
Washington, D. C.

Material collected elsewhere in the country may be sent to the nearest of the Survey's cooperative wildlife research laboratories at various State research and educational institutions, as follows:

Biological Survey Cooperative Research Unit, Department of Zoology and Entomology, Alabama Polytechnic Institute, Auburn, Ala.

Biological Survey Cooperative Research Unit, Connecticut State College, Storrs, Conn.

Biological Survey Cooperative Research Unit, Iowa State College of Agriculture, Department of Zoology, Ames, Iowa.

Biological Survey Cooperative Research Unit, University of Maine, Orono, Maine.

Biological Survey Cooperative Research Laboratory, 223 Millard Hall, University of Minnesota, Minneapolis, Minn.

Biological Survey Cooperative Research Unit, Ohio State University, Columbus, Ohio.

Biological Survey Cooperative Research Unit, Oregon State Agricultural College, Poultry Building, Corvallis, Oreg.

Biological Survey Cooperative Research Unit, Agricultural and Mechanical College of Texas, College Station, Tex.

Biological Survey Cooperative Research Unit, Utah State Agricultural College, Logan, Utah.

Biological Survey Cooperative Research Unit, Virginia Polytechnic Institute, Blacksburg, Va.

SAFEGUARDING INVESTIGATORS AGAINST INFECTION

A number of diseases of wild animals are known to attack human beings with serious and sometimes fatal consequences. It is advisable, therefore, for investigators who work intimately with affected subjects always to be on guard in making examinations of sick or dead animals to prevent infection. Rubber gloves and antiseptics

are an essential part of every operator's equipment for post-mortem examinations. Those making autopsies of mammals or birds should be especially watchful to avoid being bitten by ticks or fleas that may be lurking in the hair or plumage, as such bites may convey the infectious organism. Among the animal diseases that may also attack man are rabies, anthrax, bubonic plague, glanders, tularemia, and undulant fever (contagious abortion).

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